

PROCEEDINGS

**1985
MANITOBA
BEEF CATTLE
SEMINAR
JANUARY 21 - 23**



MANITOBA BEEF CATTLE SEMINAR - 1985

Many of the topics in the '85 Beef Seminar deal with how to "hang in there" in the beef business. We have emphasized the practical this year, with special attention paid to improving your feeding and utilizing crop residues. Good commercial displays and more chances for discussion. A special "thank you" to the Manitoba Beef Cattle Performance Association for their involvement with this year's seminar.

Monday, January 21

4:00 - 6:00 P.M. Registration
6:00 Supper - Agricultural Extension Centre

Evening Chairman - Norm Hemstad, Extension Livestock Specialist, Manitoba Agriculture

7:00 Premier Breeder Awards
8:00 "My Livestock Operation" - Doug Howe, Moose Jaw, Saskatchewan
9:30 Recreation Room - Ag Extension Centre

Tuesday, January 22

Morning Chairman - Dr Gunther Rahnefeld, Canada Agriculture, Brandon
8:30 A.M. "Basic Cow-Calf Nutrition for Higher Producing, Heavier Milking Cows"
- Dr. Larry Corah, Kansas State University
10:00 Coffee and visit commercial displays
10:30 "Factors Influencing Production of Quality Hay"
- Dr Neal Martin, University of Minnesota

Afternoon Chairman - John McKinnon, Beef Program Specialist, Manitoba Agriculture
12:00 noon Lunch - Ag Extension Centre
1:00 P.M. "Processed Crop Residues as Alternate Feed Sources"
- Jack Kernan, Saskatchewan Research Council, Saskatoon
2:00 "Does it Pay to Renovate?" - Dr Neal Martin
3:00 Coffee and visit displays
3:30 "Implants - what's their status?" - Dr Larry Corah
5:30 Supper - Ag Extension Centre

Evening Chairman - Bill Grabowsky, Livestock Specialist, Manitoba Agriculture
7:00 P.M. "Trying to Survive" - Jim Leachman, Leachman Cattle Company, Billings, Mont.
9:30 Recreation Room - Ag Centre

Wednesday, January 23

Morning Chairman - Earl Geddes, President Manitoba Beef Cattle Performance Association
8:30 A.M.

Drug Abuse - "Let Me Count The Ways"
and

Humane Treatment for animals or "Straw and Snowballs aren't Enough"
- Dr. Frank Baker, Director of Veterinary Field Services
Manitoba Agriculture

"Services Available to Producers and How to get the Most out of it"
- Dr. Jim Neufeld, Manitoba Agriculture's Veterinary Lab., Winnipeg

11:30 Conference Wrap-up
12:00 Lunch - Ag Centre
1:00 Free to visit
Canada Agriculture Research Station
and the
Douglas Bull & Heifer Test Stations



SEMINAR SPEAKERS

- FRANK BAKER is Manitoba Agriculture's extension veterinarian. Frank's practical approach to animal health has won him the respect of cattlemen all over the province.
- LARRY CORAH comes to us from Kansas State University where he is presently working on how best to use crop residues in livestock rations.
- DOUG HOWE is well known in central Saskatchewan for his practical approach to livestock production. He will talk about his own medium size cattle operation.
- JACK KERNAN is with the Saskatchewan Research Council and will discuss the effectiveness of various sources of feed.
- JIM LEACHMAN plans to talk about how to stay in the livestock business when times are tough.
- NEAL MARTIN is one of the top forage people in this continent and he knows Manitoba conditions.
- JIM NEUFELD is with Manitoba Agriculture's Veterinary Diagnostic Lab and he will explain how producers can get the most out of it.

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"MY LIVESTOCK OPERATION" - Total Performance
by

Doug Howe, Moose Jaw, Sask.

1.

Sometimes when we talk of performance we automatically think of average daily gain or weight per day. Being involved in a breed of cattle that's base was built on performance. I believe that these two qualities are very important and we must keep these in mind in raising beef cattle.

The Charolais breed came to Canada about 30 years ago through imports from the United States. These cattle had a problem with disposition and in some cases their hair coats were short and fine and they did not stand out cold winters as well as they should. But they crossed well and their offspring did well. In 1965 our first direct French imports came from France. These were high performance good haired cattle that had their fair share of structural faults.

The Charolais breeders of Canada had the challenge of taking the best of the imports both from the United States and France, working with them and making these a strong Canadian Charolais breed.

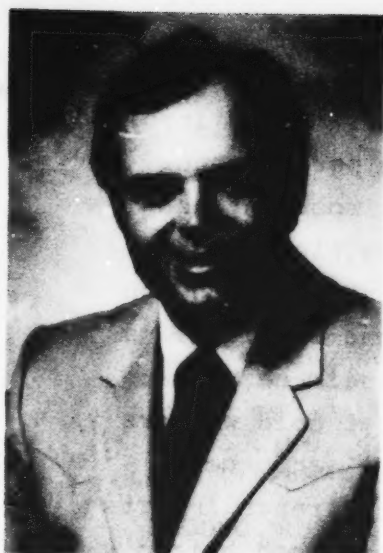
Total Performance. A functional breed for Canada today must look at all the economical traits that we must have in today's beef animal.

This starts with a cow that must go to pasture and raise a good calf and rebreed continually for 8 to 10 years on an average. In my opinion a true evaluation of calf crop is the number of calves dropped compared to the number of cows exposed the previous year.

In the herd bull battery we must have good growth from birth to a minimum of year of age, and they must always have good testicle development to ensure they are capable of servicing a good number of cows. With good structural soundness.

We have many types of cattle in our breed as most all beef breeds in Canada do today. I believe it is good to have different types from the extremely long tall framey cattle to the heavy muscled meat cattle. But we must keep in mind what the rancher, feedlot, packer and most of all the consumer demands in the product they are purchasing. Bottom line is what they can make the most of the dollar they spend.

In total performance we must keep economical, structural sound, growthy cattle. To keep our beef product competitive with the rest of the meat products of today.



BASIC COW-CALF NUTRITION FOR HIGHER PRODUCING, HEAVIER MILKING COWS

Larry R. Corah
Kansas State University

Traditionally, commercial cow-calf production has yielded a low return on investment. In recent years, the commercial cow producers have had to take a hard look at their production system and look for ways of improving the productivity, efficiency and hopefully the profitability of the commercial beef herd. All of this has lead to taking a harder look at keeping a higher producing cow. Let's examine some questions related to managing this more productive cow.

1. IS A MORE PRODUCTIVE BEEF COW NEEDED IN THE BEEF CATTLE INDUSTRY?

In looking at the factors that influence profits in a commercial cattle operation, there really are four factors that influence the returns. They are:

1. Weaning Weights
2. % of Cows Weaning Calves
3. Cost of Maintaining the Cow Per Year
4. Price of the Calves

Obviously, there are many factors that go into each of these four points. Likewise, there is a tremendous amount of interrelationship between the four points and how they influence the profit potential of the cow herd. In evaluating the economic returns from a cow herd, the pounds of calf produced per cow in the herd times selling prices equates the gross return from the cows. From this gross return has to come the cost of maintaining the cow. The following table shows the relationship of the percent of the cows weaning calves and the actual weaning weights of the calves. As we can see from Table 1, even if weaning weights of 500 pounds are achieved, if only 80% of the cows are weaning calves, the average pounds produced per cow in the herd is 400 pounds.

TABLE 1. INFLUENCE OF WEANING WEIGHT AND PERCENT CALF CROP
ON THE LBS OR (KG) OF CALF PRODUCED/COW IN THE HERD

Weaning Weight (Kg)	% Weaning Calves			
	100%	90%	80%	70%
400 (181.8)	400 (181.8)	360 (163.6)	320 (145.5)	280 (127.3)
450 (204.5)	450 (204.5)	405 (184.1)	360 (163.6)	315 (143.2)
500 (227.3)	500 (227.3)	450 (204.5)	400 (181.8)	350 (159.1)
550 (250.0)	550 (250.0)	495 (225.0)	440 (200.0)	385 (175.0)

The following table (Table 2) relates what selling prices coupled with calf crop percentage and weaning weight means in terms of gross return per cow. The key to utilizing this table is understanding what it is costing to maintain a commercial beef cow per year.

TABLE 2. INFLUENCE OF WEANING WEIGHT AND PERCENT CALF CROP ON DOLLARS PRODUCED/COW

<u>Weaning Weight of Calves (Kg)</u>	<u>% Cows Weaning Calves</u>	<u>Sale Price/Calf</u>	
		<u>\$1.00/lb.</u>	<u>\$.70/lb.</u>
400 (181.8)	90	\$360	\$252
	70	\$280	\$196
450 (204.5)	90	\$405	\$283
	70	\$315	\$220
500 (227.3)	90	\$450	\$315
	70	\$350	\$245

Annual Cow Costs = ?

It becomes very obvious that in today's beef cattle industry commercial beef cows producing 400 to 450 pound calves are not going to be a profitable entity. The only potential for making the cow herd profitable is a considerable increase in calf price or to utilize a higher producing cow. The more productive cow has been the trend for much of the commercial beef cattle industry in the United States and Canada.

2. HOW MUCH INCREASE IS THERE IN THE NUTRITIONAL NEEDS OF A MORE PRODUCTIVE COW?

To create a more productive cow, two things will probably happen. First of all and most importantly, there will be an increase in milk production. However as we also select for faster gaining cattle there will be a tendency for a more productive cow to be slightly heavier. As one evaluates the influence of weight and milk production on the nutrient needs, it becomes very apparent, that increases in cow size does not have nearly as much impact on nutritional requirements as does increased milk production. In the following table, we can see that for each 10% increase in the cow size, there is approximately a 5-7% increase in the nutritional requirements of that cow.

TABLE 3. RELATIONSHIP BETWEEN COW SIZE AND MILK PRODUCTION

<u>Cow Size (Kg)</u>	<u>Milking Level</u>	<u>TDN Needed- Lbs/Day (Kg/Day)</u>	<u>Crude Protein- Lbs/Day (Kg/Day)</u>
1000 (454.5)	Average	11.5 (5.2)	2.0 (.90)
1100 (500.0)	Average	12.1 (5.5)	2.0 (.90)
1200 (545.4)	Average	12.8 (5.8)	2.1 (.95)

In contrast as milk production increases there is a dramatic influence on TDN, protein, mineral and vitamin needs. For example, a 5 pound increase in milk production per cow per day increases TDN requirements by 10%, crude protein requirements by 12-15% and the mineral requirements by 12-15%. Thus, in the following table we can see the interrelationship of cows size and milking ability and the fact that increased milk production is the factor that really puts an added nutritional strain on the cow.

TABLE 4. RELATIONSHIP BETWEEN COW SIZE AND MILK PRODUCTION

<u>Cow Size (Kg)</u>	<u>Milking Level*</u>	<u>Lbs TDN Needed (Kg)</u>	<u>% Increase</u>	<u>Lbs Crude Protein (Kg)</u>	<u>% Increase</u>
1000 (454.5)	Average	11.5 (5.2)		2.0 (.90)	
	Superior	13.8 (6.3)	20%	2.5 (1.13)	25%
1100 (500.0)	Average	12.1 (5.5)		2.0 (.90)	
	Superior	14.5 (6.6)	20%	2.6 (1.18)	30%
1200 (545.4)	Average	12.8 (5.8)		2.1 (.95)	
	Superior	15.2 (6.9)	19%	2.7 (1.22)	29%

*Average = 10 Lbs (4.5 Kg)
Superior = 20 Lbs (9.0 Kg)

Another factor associated with the increased nutritional needs of a heavier milking cow is the cow will tend to lactate at a higher level for a longer lactation period. This is highly advantageous because when we look at the actual pounds of calf weaned per cow in a herd, not only is growth rate a key factor, but the age of that calf at weaning is a key component. In some commercial cattle operations, it is desirable to leave the calf on the cow until 6-8 months of age. Cows capable of producing milk during this whole period of time tend to be "thinner" at the time the calves are weaned. This totally changes the nutritional needs of this cow for the period between weaning and the next calving. Instead of "roughing" these cows during this period utilizing low quality feed, a heavier level of winter feeding is going to be needed. Your research in Canada is indicating that spring calving cows entering fall in a thin condition will require from 5 to as much as 10% more feed during the winter period of time so they enter calving in adequate flesh. As previous research has shown and indicated in the following table, it is extremely imperative that for cows to maintain a high level of reproductive efficiency, they must not enter the calving period in a thin condition.

With these higher producing cows that enter weaning time in a thin condition, a weight gain of 50 to at least 100 pounds may be required to maintain proper reproductive functions.

TABLE 5. RELATIONSHIP OF CONDITION AND % COWS CYCLING 60 DAYS POST-PARTUM

Condition at Calving	Weight Change Pre-Calving	Weight Change Post-Calving	% Cycling 60 Days Post-Calving
Good	Lost	Gained	90%+
Good	Lost	Lost	90%+
Moderate	Gained	Lost	74%
Moderate	Lost	Lost	48%
Thin	Lost	Gained	46%
Thin	Lost	Lost	25%

3. CAN WE MAINTAIN REPRODUCTIVE EFFICIENCY WITH HIGHER PRODUCING COWS?

The question today in the beef cattle industry is not really whether we can maintain reproductive efficiency in higher producing cows but it is really will and can the commercial cattle producer adjust his management program and nutritional philosophies to accommodate the added nutrient demands of a higher producing cow? Ample research evidence clearly indicates that normal reproductive performance can be maintained in more productive cows provided the added nutrient needs are met. The real dilemma facing the commercial cow-calf producer is the fact that the nutritional needs will be increased and thus some change in managerial philosophy must occur to accommodate the more productive cow. This is often easier said than done. In certain areas of Canada, a cow with greater lactating potential may have reproductive problems simply because there is not an adequate supply of feed available.

Thus, in making the decision in going to a more productive cow, the producer needs to consider the resources available. If there is an abundant supply of feed of high quality, a heavier, larger milking cow can easily be maintained. If the feed supply is limited or if environmental conditions such as drought frequently occur, reducing reproductive rates, maintaining a slightly smaller, somewhat lower producing cow may be the most functional cow for that environment.

4. ARE MORE PRODUCTIVE COWS LESS EFFICIENT?

Considerable research has been done on the whole concept of cow efficiency and unfortunately the findings are not consistent. The following table reviewing 13 research trials makes it fairly obvious that there are variations in the findings. It is difficult to determine why the variations exist but obviously one of the factors that will influence cow productivity is the environment and management condition under which the cow is maintained. In evaluating any research trial a key question is whether the cows were fed an adequate amount of feed to allow her to express her production potential which is best measured by reproductive efficiency. In other words, if larger, heavier milking breeds are not fed extra feed to allow for proper reproductive rates, the study may favor the smaller, lighter milking breeds. However, this is reality in the beef cattle industry. As we have selected both within breeds and among breeds we are often currently maintaining a larger, heavier milking cow in the cattle industry. But, unfortunately if we utilize the nutrition and management program that was used in the past with lower producing cows, reproductive efficiency will suffer.

As a general summary of the research, it would tend to indicate that the pounds of feed required to produce a pound of calf or pounds of feed to produce a pound of carcass weight will be fairly similar among the various breeds. The research data, however, indicates that tremendous variation in efficiency exist within a breed. Most research studies indicate that using actual weaning weights is a good indicator of both reproductive efficiency and cow efficiency.

TABLE 6. SUMMARY OF COW EFFICIENCY TRIALS MEASURING CALF WEANING WEIGHT PER UNIT OF ENERGY CONSUMED BY COW AND CALF (BIOLOGICAL EFFICIENCY)

Trial	Breeds Studied ^a	Conclusions
Texas, 1967	HH, CH	No difference between breed groups.
Oklahoma, 1973, 1975, 1976	HH, HHxH, H	No difference when each breed group fed to potential level of production.
Ohio, 1976	HH, ANxHH, CHxHH, CH	ANxHH more efficient in producing weaning weight-no difference in energy required per pound of slaughter weight.
Michigan, 1978	Unselected HH Selected HH SMxCHxANxHH, SMxHxANxHH	Crossbred cows were more efficient than HH cows.
Alberta, 1980	ANxHH, CHxAN, JxAN, SMxAN	No difference between breed groups.
South Dakota, 1980	ANxHH, ANxCH, CHxAN, CH	No difference between breed groups.
Purdue, 1980, 1982	HH, ANxHH CHxHH, BxHH	No difference between crossbred breed groups; however, straightbred Herefords were less efficient.
Oklahoma, 1981, 1982	HHxAN, SMxAN, SMxHH, BxAN, BxHH, JxAN, JxHH	HHxAN, SMxAN, and SMxHH less efficient than other breed crosses as a result of lower reproductive rates.
MARC, 1982	ANxHH, Ch-X J-X, SM-X	Simmental-X cows were less efficient than ANxHH. Measured only maintenance energy requirements.
South Dakota, 1983	HH, SMxHH, ANxHH	No difference between breed groups.
Montana, 1983	AN, HH, CH, ANxHH ANxCH, HHxCH	No difference between breed groups, but considerable variation within breed.
Wisconsin, 1983	HHxH, SMxH, ANxH, CAxH	No difference between breed groups.
MARC, 1983	HHxAN, RP-X, B-X, GV-X, MA-X, CA-X	Gelbvieh and Chianina crosses were less efficient than other breed crosses except Brown Swiss crosses. Measured only lactation output/input.

^a AN=Angus, B=Brown Swiss, CA=Chianina, CH=Charolais, GV=Gelbvieh, H=Holstein, HH=Hereford, J=Jersey, MA=Maine Anjou, RP=Red Polled, SM=Simmental

5. WHAT ARE LIKELY TO BE THE MAJOR PROBLEMS WITH HIGHER PRODUCING COWS?

The key problem that is likely to occur with higher producing cows is trying to maintain reproductive efficiency. This will be particularly apparent with heifers calving for the first time at two years of age. If an adequate level of reproductive efficiency can be maintained with first calf heifers, it probably is indicative that a high rate of reproductive efficiency for the whole herd will be able to be achieved.

There are a number of management practices with first calf heifers that should be followed to insure that reproductive efficiency will be maintained. First of all, replacement heifer calves need to be grown out properly from the time they are weaned until bred at 12 months of age. In the past we used to say 65% of the mature weight should be achieved by the time they reach 12-14 months of age (breeding time). This may in actual fact be too low and possibly it should be as high as 70% or having these higher producing heifers in the range of 650 to 800 pounds may be important.

Likewise, continued growth and development from the time they are bred until they calve at two years of age is important. This is especially important to insure proper development to eliminate calving problems and to insure that they rebreed after their first calf. Having the heifers weigh from 1000 to 1100 pounds at the time they calve at two years of age may have to be a targeted goal in many cattle operations. To achieve this it is going to be important that first calf heifers are separated from mature cows. Secondly, with these higher producing females, extra time after the first calf is needed to insure that the cows are cycling at the start of the breeding season. It is a good management practice in any commercial beef cattle operation to calve first calf heifers two to four weeks ahead of mature cows. However, with more productive females it may be imperative that they have the extra two to four weeks to insure adequate rebreeding after the first calf.

6. ARE WE OVER-EMPHASIZING GROWTH RATE IN THE BEEF CATTLE INDUSTRY?

The question that many commercial cow-calf producers raise is are we getting our cows too big and are we getting too much milk production to be biologically efficient on our commercial operation? As we put emphasis on growth, cow size has tended to increase and concurrently certain managerial problems like increased birth weights resulting in more calving difficulty has resulted in the cattle industry.

As we evaluate the factors influencing the profitability of stocker and feedlot cattle, it becomes very imperative that growth rate is one of the key factors that will influence profitability. As indicated earlier, weaning weights is a key component influencing the profitability of cows and the genetic growth potential of the calves is an obvious component of weaning weights.

Thus, in most commercial cow-calf operations, continued emphasis on growth seems to be imminent and needed. We are also in the era of considerably more sophisticated genetic information being available to the commercial cow-calf producer. Thus, in selecting sires for the operation, more sophisticated genetic information will be available as an aid.

As we look at trying to make the commercial cow-calf industry a more profitable entity, it seems very apparent that selecting for growth needs to be continued. For example, one of the things that makes the beef industry more efficient is retained ownership of calves from birth to slaughter. This would eliminate many of the health problems that occur in the beef cattle industry and allow the commercial cow-calf producer to take full advantage of the superior genetics that he is utilizing in his cattle.

A classic illustration of the improvement in production efficiency that can be made is the data collected by a producer in southern Kansas who retained ownership of straight Angus cattle from birth to slaughter. His cost of gain in the feedlot was approximately 5-8¢ lower compared to the average of the other cattle in a 20,000+ feedlot.

TABLE 7. FEEDLOT DATA FROM PROGENY TEST STEERS (1981-83)

<u>Year</u>	<u>No. Steers</u>	<u>Gross Wt.</u>	<u>Net Wt.- 4%</u>	<u>Average Daily Gain</u>	<u>Cost of Gain Cwt.</u>	<u>Days on Feed</u>
1984	63	1224 lbs	1175 lbs	3.6 lbs	\$47.00	116
1983	70	1213 lbs	1164 lbs	3.28 lbs	51.12	138
1982	56	1196 lbs	1148 lbs	3.21 lbs	43.74	131
1981	75	1154 lbs	1108 lbs	3.24 lbs	43.75	138

FEEDLOT DATA FROM 6 KANSAS FEEDLOTS SAME TIME AS STEERS ABOVE

<u>Year</u>	<u>No. Steers</u>	<u>Net Wt.</u>	<u>Average Daily Gain</u>	<u>Cost of Gain Cwt.</u>	<u>Days on Feed</u>
1984	14,396	1168	3.18	57.11	120
1983	13,700	1156	3.10	58.34	124
1982	12,331	1154	3.21	48.96	129
1981	11,347	1150	3.11	52.26	137

Conclusion

In essence, it seems imperative for the commercial beef cattle industry to become more profitable continued improvement in the productivity of the commercial cow herd will occur. To achieve this, an increase in milk production and to some extent an increase in cow size will occur. To compensate for this, the cows are going to have to be on a higher plane of nutrition to insure that proper reproductive efficiency is maintained. In return, an improvement in the pounds of calf weaned per cow in the herd can be achieved.

Producing Quality Hay for Beef Cattle

Neal P. Martin ^{1/}

Forage crops provide at least 90% of the nutrients required for beef production. Dry, pregnant mature beef cows in good condition can maintain their body weight on a full feed of a variety of low quality forages. Beef cows in many cases become scavengers of poor forage or salvage feeding value of forages otherwise of no value. The ability of dry cows to exist on low quality forages has allowed the producers to except forage quality standards below nutrient requirements, particularly for those classes of beef cattle that need performance above maintenance of body weight. The purpose of this paper is to outline quality standards required by the more productive classes of beef cattle, such as growing heifer or steer calves, pregnant yearling heifers and nursing cows.

Protein and Energy Requirements

Protein and energy (TND) requirements for various classes of beef cattle are listed in Table 1. The quantity of protein and TDN required per day for a given body weight and performance, daily gain, are listed with suggested intake quantities. Thus, the quantity of nutrients consumed by the animal is a function of the concentration of each nutrient in the forage and the dry matter intake.

The TDN and intake requirements of growing heifers and pregnant yearling heifers dictate the use of the highest quality forage of any class of beef cattle listed in Table 1. In recent years, forage quality evaluation has included fiber tests that can be used to estimate potential intake of dry matter as well as concentrations of protein and TDN. A listing of quality standards of legume and grass hays is needed to assess standards required for productive beef cattle.

Forage Quality Standards

The quality standards proposed by the Hay Marketing Task Force of the American Forage and Grassland Council for legumes and grasses are listed

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Table 1. Daily nutrient requirements of beef cattle (growing heifers, yearling heifers and cows).

Body weight, lb	Daily gain, lb	Daily DM intake		Total protein		TDN	
		lb	lb/100 BW	lb	%	lb	%
-----Growing heifer calves-----							
450	1.0	14.0	3.1	1.28	9.1	7.7	55
450	1.5	15.3	3.4	1.34	8.8	8.4	55
550	1.0	15.1	2.7	1.36	9.0	8.3	55
550	1.5	16.5	3.0	1.36	8.2	9.1	55
650	1.0	18.0	2.8	1.47	8.2	9.9	55
650	1.5	18.9	2.9	1.47	7.8	10.4	55
-----Pregnant yearling heifers, last 3 to 4 months of pregnancy-----							
700	1.3	18.7	2.7	1.65	8.8	9.9	53
800	1.3	19.6	2.4	1.75	8.9	10.6	54
-----Dry, pregnant, mature cows, middle third of pregnancy-----							
1000	---	14.8	1.5	0.86	5.8	7.9	53
1200	---	17.0	1.4	1.00	5.9	9.2	54
-----Dry, pregnant, mature cows, last third of pregnancy-----							
1000	0.9	14.8	1.5	1.06	7.2	9.4	63
1200	0.9	17.0	1.4	1.19	7.0	10.7	63
Cows nursing calves, first 3 to 4 months postpartum, avg. milking ability							
1000	---	20.5	2.0	1.90	9.3	11.0	54
1200	---	22.7	1.9	2.14	9.4	12.3	54

SOURCE: Arthaud et al. 1982. MN Beef Cow-Calf Report C-44.

in Table 2. Two fiber tests, acid-detergent fiber (ADF) and neutral detergent fiber (NDF) are used to predict dry matter digestibility (DDM) or TDN concentrations and dry matter intake, respectively. Then, DMI and DDM are combined to estimate potential digestible dry matter intake, identified as relative feed value (RFV) index (Table 1). Note that legumes and grasses do not differ significantly in ranges of percent DDM within relative maturities, but their potential intakes and RFV's differ substantially. Thus, grasses or mixtures dominated by grasses don't grade higher than number 2, because of intake restrictions.

In Arthaud's Cow-Calf Day Report (C-44, 1982), he suggests that growing heifers should receive high quality forage and suggests that the producer test hay for protein. Based on this discussion, that recommendation should be expanded to include a fiber test. When protein is the only indicator of quality and hays are fed slightly above protein requirements of the animal, highly productive classes of beef cattle can be short of TDN, unless supplemented with grain. Note that 550 lb growing heifers

gaining 1.5 lbs/day require 1.36 lbs of protein or 8.2% crude protein, when 16.5 lbs of dry matter is consumed (Table 1). Using crude protein as a sole criteria, we find that a grade 4 grass or grass-legume mixture (Table 2) will adequately supply the protein needs, but will not meet all the TDN requirements ($2.2 \text{ lb}/100 \text{ lb of body weight} \times 5.5 \times .50 = 6.0 \text{ lbs of TDN}$). Hence, the remaining 3.1 lb of TDN must be supplied by an alternate energy source such as corn or barley or feeding a higher quality hay can provide the energy, but provides extra protein.

Table 2. Proposed quality standards for legume and cool season grass hays.

Stand- ard	Stage of maturity	Quality analysis			Calculated values			
		CP	ADF	NDF	RFV ^{1/}	%DDM ^{2/}	DM ^{3/}	%TDN ^{4/}
					index		intake	
lb/100 lb BW								
-----Legume or legume-grass mixtures-----								
Prime	Pre bloom	>19	<31	<40	>132	>65	>3.1	>61
1	Early bloom	17-19	31-35	40-46	118-132	62-65	2.9-3.0	56-61
2	Mid bloom	13-16	36-41	47-51	101-117	57-61	2.7-2.8	49-55
3	Full bloom	<13	>41	>51	<101	<57	<2.6	<49
-----Grass or grass-legume mixtures-----								
2	Pre head	>18	<33	<55	>109	>63	>2.6	>58
3	Early head	13-18	33-38	55-60	93-109	59-63	2.4-2.5	53-58
4	Head	8-12	39-41	61-65	80-92	57-58	2.2-2.3	49-52
5	Post head	<8	>41	>65	<80	<57	<2.2	<49

^{1/} RFV index = $\text{DDMI} ((\% \text{DDM} \times \text{DMI in g/w}^{.75} \text{kg}) / 100) \times 1.435$.

^{2/} %DDM = $88.9 - (.779 \times \% \text{ADF})$; Rohweder et al. In Marble, 1984.

^{3/} DM intake in lb/100 lb BW = $\text{DMI in g/w}^{.75} \text{kg} \times .0217$.

DMI (g/w^{.75}kg) = $1.75 (96.4 - .0003 \times \text{CP}\% - .0482 \text{ NDF}\% - .0085 \text{ NDF}\%^2)$.

^{4/} %TDN = $96.35 - (\text{ADF}\% \times 1.15)$.

SOURCE: Adapted from Rohweder et al. 1983. Proc. XIV Int'l Grass. Congr. pp. 534-538.

If it is desired to supply cattle with as many nutrients from hay as possible, we must use RFV index as the key quality indicator. Thus, a growing heifer requires a grade 2 hay, pregnant yearling heifers number 3, and cows standards 4 or 5.

A greater concern of beef cattle producers is that some may be expecting too much performance from a poor quality hay. We collected 110 hays from within Minnesota for chemical analysis to develop near infrared reflectance (NIR) prediction equations. In the group I've listed are those hays analyzing less than 10% crude protein (Table 3). If we would allow cows to have a full feed of these hays, two would not provide enough TDN for a dry, pregnant cow in the middle third of pregnancy (6.9 and 7.8 vs 7.9 - Table 3 vs 1). Thus, we must test hays to determine TDN

intake, feed hays above 2.64 lbs of protein or add supplemental grains to insure sufficient performance and productivity of the breeding herd.

Table 3. Quality tests of selected (<10% CP) low quality hays collected in Minnesota in 1982 for development of NIR (near infrared reflectance) equations.

Species	Stage of maturity	Quality Tests as % of Dry Weight Analysis			Calculated		lbs Dry Wt.	
		CP	ADF	NDF	TDN ^{1/}	RFV index ^{2/}	DMI ^{3/}	TDN ^{4/}
R. canary-grass	seed	6.8	46.6	72.2	42.8	64	1.8	7.9
Mixed grass	seed	7.6	38.2	63.9	52.4	87	2.2	11.7
Grass-Red clover	f. bloom	8.5	44.3	70.0	45.4	70	2.0	8.8
Grass-Red clover	f. bloom	8.7	46.8	76.8	42.5	56	1.6	6.9
S. brome-grass	head	8.8	44.4	74.7	45.3	62	1.7	7.8
Alf-grass	?	8.9	44.7	66.5	45.0	76	2.1	9.5
Brome-Red clover	f. bloom	9.1	36.4	62.6	54.5	91	2.3	12.4
R. canary-grass	seed	9.1	41.4	68.1	48.7	76	2.0	9.9
Grass-alf	f. bloom	9.4	44.4	69.2	45.3	71	2.0	9.0
Grass-alf	1/2 bloom	9.8	37.5	64.1	53.2	88	2.2	11.8

^{1/} TDN = 96.35 - (ADF% x 1.15).

^{2/} RFV index = DDMI ((%DDM x DMI in g/w^{.75}kg)/100) x 1.435.

^{3/} DM intake in lb/100 lb BW = DMI in g/w^{.75}kg x .0217. DMI (g/w^{.75}kg) = 1.75 (96.4 - .0003 x CP% - .0482 NDF% - .0085 NDF%²).

^{4/} Potential TDN intake for 1000 lb mature cow.

Factors Influencing Quality of Hay

Hay quality is influenced by the stage of maturity at harvest, species (particularly the legume-grass ratio), rain damage both in the windrow and in large packages stored outside, harvest methods and storage conditions. Further examination of the standards listed in Table 2 suggest the two single most important factors influencing hay quality are maturity and legume-grass ratio. In those proposed standards a full bloom legume hay is assigned a RFV index of 100; legume grade 3. In northern Minnesota, legumes and grasses should be cut 2 to 3 times per season if high quality hay is desired. For a three-cut program the first cut must be taken early, June 5-15. When the first cut is removed early, quality of both the first and second are influenced more by advancing maturity than the third harvest. It normally takes 2 to 3 weeks for first and second cutting alfalfa to mature from bud to full bloom stage of maturity. Thus, protein and digestible dry matter decline about .33 and .38 percentage points per day. The third harvest is often a dormant cutting;

one taken late enough in the fall that little regrowth occurs before dormancy is established.

Crude protein concentration can be increased in cool season grasses to equal that of legumes by adding nitrogen fertilizer, but inferior intake of grass cannot be changed unless hay is treated chemically. Thus, management skills must be directed toward maintaining 50% or less of the mixture as grass in legume-grass hays. By definition a mixture is legume-grass until the legume content falls below 35%. Below 35% legume and above 65% grass should be identified as a grass-legume mixture.

The amount of deterioration of hay in the windrow from rain is dependent on the moisture in the hay when rain occurs, Table 4.

Table 4. The influence of stage of maturity and wetting on crude protein, in vitro digestible dry matter (IVDDM), relative feed value index and dollar feed value in alfalfa.

Alfalfa Maturity	Year 1		Year 2		
	No rain damage	2.5 cm rain 24 h after cutting	No rain damage	4.2 cm rain during curing	6.2 cm rain on dry hay
-----% crude protein-----					
Early-late bud	19.9	20.3	26.2	24.6	23.1
Late bloom	14.9	14.9	18.1	13.9	15.6
-----% IVDDM-----					
Early-late bud	67.6	65.2	72.7	57.2	49.3
Late bloom	60.1	58.8	62.3	39.2	36.0
-----RFV index-----					
Early-late bud	126	125	146	113	91
Late bloom	110	107	120	70	56
-----\$ feed value/T ^{1/} -----					
Early-late bud	96	97	119	106	96
Late bloom	76	75	89	64	65

^{1/} Substitution of protein and energy with corn, \$2.50/bu and SBM, \$10/cwt.

SOURCE: Adapted from Collins. 1983. Agron. J. 75:523-527.

Crude protein, IVDDM, RFV index, and \$ feed value (FV) decreased as alfalfa hay matured in both years. However, only IVDDM, RFV and \$FV decreased when hay was rained on while CP was not influenced by rain in all comparisons. When crude protein values did not change it was because rain damage resulted in leaching of soluble compounds such as starch; but the concentration of protein remained the same. Those soluble

constituents that were leached away are highly digestible; thus, digestibility, percent IVDDM, decreased due to rain damage. Note that advancing maturity resulted in larger losses in quality and \$/T than rain damage. Rain damage results in a greater loss in quality when dry hay is rained on (6.2 cm rain in year 2 vs 2.5 cm water in year 1, Table 4). In addition, RFV index which is determined from fiber tests is more effective in determining quality of rain damaged hay than percent CP.

Other factors influencing quality of hay are harvest methods and storage methods. Of these two factors, harvest loss is highest. Harvest losses during mowing, curing, raking and baling of hay range from 10% to 61% of total dry matter grown. A recent study at Morris showed harvest method also influences forage quality (Table 5). Of all harvest methods studied (greenchop, wilted silage, compressed stacks, conventional square bales, large round bales - 1200 lbs and small round bales - 700 lbs), the highest quality (%CP and %TDN) was found with compressed stacks or conventional square bales. Highest dry matter loss and lower quality forage was shown for the round bales. Not all round bales will result in reduced quality, but producers should be aware of potential losses and manage their harvest operations to minimize loss of leaves; thus maintaining quality of the forage at harvest.

Table 5. The influence of harvest method on yield and quality of alfalfa, Morris, MN.

Harvest Method	DM Yield		Quality Tests as % of Dry Weight			
	T/A	% loss	Analysis			Calculated
			CP	ADF	NDF	TDN ^{1/}
Green chop	1.16	----	20.7	32.2	47.4	59.3
Wilt silage	1.04	10	19.3	34.4	48.0	56.8
Stacks, Cpr.	1.04	10	20.1	30.2	47.4	61.6
Sq. bales	.97	16	19.8	31.6	48.3	60.0
Lrg. Rd. bales	.81	30	18.8	34.5	49.1	56.7
Sm. Rd. bales	.78	33	18.0	35.6	48.3	55.4

^{1/} TDN = 96.35 - (ADF% x 1.15).

SOURCE: Adapted from Johnson et al. 1982. Proc. 1982 F & G Conf. p. 69.

Forage Testing

A complete forage analysis, DM, CP, ADF and NDF is the best alternative, even to beef producers. Use the formulas cited in the footnotes of Table 3 to calculate DDM and intake potential. However, with current chemical tests it becomes too expensive to test forages for all the fiber tests. Current prices for DM, CP, ADF and NDF range from \$15 to \$29 per sample.

The Agricultural Extension Service at the University of Minnesota, University of Wisconsin and Pennsylvania State University are developing a new, rapid computerized forage analysis called NIRS, near infrared reflectance spectroscopy. NIRS is as accurate as current chemical tests,

it's faster and will make forage testing more economical. Our NIRS mobile unit service charge to analyze a forage for DM, CP, ADF-CP, ADF, NDF, and selected minerals (calcium, phosphorus, magnesium and potassium) is \$10 per sample.

Summary

Beef cow-calf producers require good quality hay or silage for their most productive cattle. Providing higher quality forage to the breeding herd is a sound investment in the future, not a cost. Beef cow-calf producers should be attempting to harvest some good quality forage, grade 2. This requires harvesting legumes such as alfalfa or red clover in pure stands or in mixtures with grass with at least 50% of the mix being legume. Southern growers should harvest three times per year and northern growers at least twice. In general, higher yields of alfalfa obtained in the Minnesota Alfalfa Grower Program required higher production costs per acre, but resulted in reduced costs per ton. Increasing yield and quality of selected fields should improve the economics of a cow-calf operation.

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MAKE PASTURE RENOVATION PAY: AGRONOMIST VIEW

Neal P. Martin^{1/}

Beef cattle are a major source of farm income in Minnesota. More than half of the beef cows in Minnesota are in the Northern half where forage crops comprise over half of the farmland. Like many beef-crop operations in North America, production of beef is far below its potential. Management levels on forage crops and pastures suggest that improvements in beef production and efficiency can be made; however, the economic incentives are often less attractive than other cropping or livestock options. Nevertheless, successful use of pasture renovation holds the key to improving both pasture carrying capacity and animal performance. This discussion will focus on how pasture renovation can result in improvements in beef production that will also be profitable.

Pasture Renovation

Pasture renovation is defined as "improvement of a pasture by the partial or complete destruction of the sod, plus liming, fertilizing, seeding and weed control as may be required to establish desirable forage plants." Pasture improvement is a broader term which includes pasture renovation as one choice compared to other management choices such as, fertilization, weed and brush control, and grazing method. Time will not allow for a comparison of all of these improvement options, but pasture renovation deserves a closer analysis. As my economist colleague, Paul Hasbargen reminds me often, not all pasture improvement pays. Simply stated, "the returns must be higher than the costs." Returns are always a function of price, but also in relation to renovation must be a function of price per added unit of carrying capacity (or a function of improving an animal's performance, average daily gain or calving percentage).

Using feeder cattle price relationships of the past 30 years and gains equal to those obtained by grazing yearling cattle on the Kenner ranch, a demonstration farm in Northwestern Minnesota, the added returns per animal unit month (AUM) would be \$20. Note that in an economic comparison of pasture systems on two Northern Minnesota ranches, Table 1, two systems barely pay for themselves (added cost/AUM was \$19.73 and \$19.01 with system C, Kenner's and system AA, Disterhaupt's, respectively). Incidentally, in all my comparisons, system A is an unimproved pasture dominated by Kentucky bluegrass and quackgrass, not fertilized, no weed control, but is grazed at a grazing pressure equal to other systems compared on the same ranch. System AA did not require renovation, 50 pounds/A of N was added annually to pastures divided in half and grazed rotationally. System C contained a renovated pasture of

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24 acres of alfalfa-grass mixture, and B contained 20 acres of birdsfoot trefoil. However, system C at Disterhaupt's and B at Kenner's returned

Table 1. The average and marginal costs^{1/} of providing pasture on ranches in northern Minnesota, 1976-79.

	Pasture systems ^{2/} on Kenner Ranch		
	A	B	C
AUM/A	1.33	3.98	3.67
Annual cost/A, \$	20.00	64.28	66.16
Average cost/AUM, \$	15.04	16.15	18.03
Added cost/A, \$	---	44.28	46.16
Added AUM/A	---	2.65	2.34
Added cost/AUM, \$	---	16.71	19.73

	Pasture systems ^{2/} on Disterhaupt Ranch		
	A	B	C
AUM/A	1.45	2.40	5.60
Annual cost/A, \$	25.00	43.06	78.36
Average cost/AUM, \$	17.24	17.94	13.99
Added cost/A, \$	---	18.06	53.36
Added AUM/A	---	.95	4.15
Added cost/AUM, \$	---	19.01	12.86

^{1/} Costs adjusted to 1982 prices.

^{2/} A, unimproved pasture; B, fertilized grass and birdsfoot trefoil; C, fertilized grass and legume-grass; AA, native grass, fertilized.

SOURCE: Adapted from Hasbargen et al. 1983.

more than it costs. The birdsfoot trefoil was more profitable than alfalfa-grass at Kenner's because birdsfoot trefoil yielded .6 more AUM/A than the legume-grass, Table 2. The alfalfa stands did last longer than 3 years while the birdsfoot trefoil stand was maintained as established for 5 years. The legume-grass pasture in system C at Disterhaupt's produced 117% more AUM for the season than Kenner's (6.3 vs 2.9 AUM - Table 2). However, Disterhaupt's had a more productive soil type (clay loam vs sandy loam) and averaged 4.5 extra inches of rainfall than Kenner's.

The soil productivity and rainfall were similar between the Savich and Disterhaupt demonstrations. The carrying capacities were similar for these ranches that compared the same systems, 5.3 vs 5.6 AUM/A/season. However, note the contribution of AUM's was different on each ranch; brome leading at Savich and legume-grass at Disterhaupt. This difference can be attributed to the species of grass and the rancher's method of use. Savich harvested 84% of this total production from brome grass as hay compared to no harvest of bluegrass at Disterhaupt's. Disterhaupt's grass pasture was too rough for harvest and he chose to harvest 1/3 of the legume-grass pasture.

Table 2. Seasonal use and carrying capacities for species components of three systems on three ranches, average of four years.

Ranch (season rainfall, inches)	Pasture system ^{1/}	Pasture in the system by species	Days grazed	AUM/A		
				grazed	cut	total
Savich ^{2/} (18.9)	C	S. bromegrass ^{3/}	18	1.0	5.3	6.3
		Legume-grass	83	3.3	1.3	4.6
			<u>101</u>			5.3 ^{4/}
Disterhaupt (23.0)	C	K. bluegrass	62	4.6	---	4.6
		Legume-grass	74	4.1	2.2	6.3
			<u>136</u>			5.6 ^{4/}
Kenner (18.5)	B	K. bluegrass	61	3.1	1.2	4.3
		B. trefoil	71	3.5	---	3.5
			<u>132</u>			3.9 ^{4/}
	C	S. bromegrass	36	2.0	3.1	5.1
		Alfalfa-grass	90	2.7	0.2	2.9
			<u>126</u>			3.7 ^{4/}

^{1/} System A (control), unimproved pasture, yielded 0.6, 1.4, and 1.3 AUM/A for each ranch listed top to bottom, respectively.

^{2/} Mean of three grazing seasons.

^{3/} N applied to grass species listed from top to bottom; 113, 121, 105, and 105 lb/A, respectively.

^{4/} Weighted mean for the system.

SOURCE: Adapted from Martin et al. 1983.

However, the highest beef/A was obtained at Disterhaupt's, 349 vs 266 lb/A of LWG (Table 3). High total beef production was attributed to two differences: 1) cross-bred cows at Disterhaupt's had faster gaining calves than the commercial herd at Savich's and 2) the extra grazing days at Disterhaupt's provided more calf gain per acre (extra pasture that was harvested was added as extra cow days rather than calves). Thus, many factors determine if renovation will result in added livestock performance.

Factors Influencing Returns From Renovation

Pasture renovation should improve yield or carrying capacity. The most important factor is to destroy the undesirable plant species and establish the desired ones.

Sod destruction is dependent on the tillage operations or, in the case of sod seeding (mechanically placing seed in little disturbed sod), the herbicide used. For pasture renovation with conventional tillage, several repeated plowings with a disk or field cultivator should be staggered far enough apart to allow grass regrowth.

Table 3. Animal performance on pasture systems on three ranches in northern Minnesota, 1976-79.

Ranch	Pasture system ^{1/}	acres	days	Average daily gain, lb		Liveweight gain/A, lb			% of control
				cow	calf	cow	calf	total	
Savich	A	94	102	1.2	2.0	20	26	46	100
	C	38	104	1.3	1.8	185	81	266	578
Disterhaupt	A	114	126	1.1	1.9	39	56	95	100
	C	38	132	1.1	2.1	158	191	349	262
	AA	80	125	1.2	2.0	63	93	156	164
Kenner ^{2/}	A	68	126		1.4	---		90	100
	B	35	127		1.4	---		253	281
	C	38	121		1.6	---		245	272

^{1/} A (control), unimproved pasture; B, fertilized grass and birdsfoot trefoil; C, fertilized grass and legume-grass; AA, native grass-fertilized.

^{2/} Grazing was done with 450 lb yearling steers and heifers.

SOURCE: Adapted from Martin et al. 1983.

The next most important factor is the method of establishment. Three choices are: 1) companion crop seeding, 2) direct seeding a pure stand of legumes with a herbicide, or 3) sod seeding (no-till renovation). Using a companion crop is most popular among our beef producers, but too often it is done at the expense of good establishment. Skills often over-looked are seedbed preparation (firm, level), modification of the grain drill to drop legume and grass seeds behind to disc and ahead of a packer to prevent burying seeds too deep, and not removing the companion crop early as forage to reduce competition for light and moisture of seedlings.

Sod seeding minimizes these management short comings, but requires a special drill and management. Our research has shown that to be successful in sod seeding, a herbicide is needed to suppress spring grass growth for 6 weeks to allow successful legume development before grass returns. The data in Table 4 show that alfalfa was best established via sod seeding with a Deere Power-til seeder^{1/} when dalapon was used at the early planting date or glyphosate at the middle two planting dates. Only paraquat and glyphosate (Roundup) are cleared for sod seeding in the U.S. Dalapon has soil activity; thus, providing suppression at early seeding before enough grass leaf growth is present for uptake of the herbicide. Glyphosate applied at .75 lb AI/A on grass 6 to 8 inches tall and actively growing, will suppress grass long enough to allow establishment of alfalfa. This same rate is effective for sod seeding a mixture of birdsfoot trefoil and red clover (6 + 2 lb/A).

^{1/} Mention of equipment does not constitute a guarantee of the product by the University of Minnesota, and does not imply its approval to the exclusion of other products that may also be suitable.

Table 4. The influence of planting date, herbicide and herbicide rate on seeding year yields of alfalfa dry matter and percent alfalfa at first harvest, average of two seasons, Rosemount, Minnesota.

Herbicide rate ^{1/}	20 April			7 May			20 May			2 Jun		
	Par	Gly	Dal	Par	Gly	Dal	Par	Gly	Dal	Par	Gly	Dal
----- lb DM/A -----												
check	190	150	320	440	170	330	430	350	240	100	70	60
low	200	880	2370	1880	1580	2550	1430	2480	1730	410	680	960
medium	280	780	3170	1260	3740	2510	1750	3800	2440	330	940	820
high	710	2570	3470	1740	2620	2360	1570	4310	2600	350	1210	1190
Average	342	1087	2312	1294	1798	1921	1279	2710	1725	299	715	750
----- % alfalfa of dry weight -----												
check	2	2	7	7	2	3	9	8	6	3	2	2
low	3	18	61	30	38	62	31	45	50	15	20	32
medium	6	10	65	26	55	82	38	74	73	11	30	28
high	15	43	80	35	49	74	34	88	70	12	39	46
Average	6	18	53	24	36	55	28	54	50	10	23	27

^{1/} Low, medium and high herbicide rates were 0.5, 0.75, and 1.0 lb/A for paraquat (Par) and glyphosate (Gly) and 3, 6, and 9 lb/A for dalapon (Dal).

SOURCE: Martin et al. 1983. Agron. J. 75:951.

Aside from obtaining a desirable stand, successful renovation depends on: 1) site selection, 2) correcting fertility deficiencies, 3) liming, 4) selection of the desirable species, 5) utilization of the proper grazing system, and 6) livestock management.

Site selection. Not all pasture or rangeland requires renovation. Choose the most productive soils and land accessible to harvest for renovation. Rocky or excessively sloping land are often best suited to native grass that is fertilized and sprayed to kill weeds. Also, either correct drainage problems or choose plant species that tolerate poor drainage.

Soil test. Conduct a soil test to determine limitations in soil pH, phosphorus, potassium, and sulfur. In some situations the fertility requirements in relation to the expected yield increase may not merit renovation. Also, if lime is required and no tillage will be used, consider species shifts or different renovation methods. Lime must be incorporated into the plow layer 6 to 12 months before seeding.

Select the best species or mixture. Consult your grazing land association information or extension service for recommendations. Legumes should receive priority over grasses because they have better seasonal production, don't require expensive N fertilizer, and give higher livestock performance than with grasses.

Alfalfa and clovers are bloat inducing legumes which require use of management to minimize risk of bloat. We require at least 50 percent of the mixture botanically to be grass and judicious use of anti-bloat forming agents with proper feeding management. Birdsfoot trefoil is a non-bloating legume. Also, consider your ability to establish forage crops. Red clover, orchardgrass and timothy are relatively easy to establish, whereas reed canarygrass and birdsfoot trefoil are difficult to establish. In addition to species selection, choose varieties tested locally that will provide good yield and persistence. With reed canarygrass, choose a low alkaloid variety to ensure best animal performance.

Use a grazing method that fits your performance and persistence goals. The grazing method influences both livestock and plant performance. Grazing pressure, or the amount of forage consumed per day, influences livestock performance. Animals requiring only maintenance should be grazed at high pressures, while yearling steers or heifers expected to gain 1.5-2.0 lb/day require a light pressure. Grazing duration influences the plants yield and persistence. Alfalfa or red clover require 30 days rest between grazing during the summer and a fall rest for maximum persistence. Grazing pressure during a seeding year should be very high (10-20 head/A) to ensure rapid defoliation, but of short duration.

Livestock management. Pastures have little value until consumed by livestock. Cattle or calves that gain fast will provide higher value of a forage than animals on maintenance. Managerial skills often overlooked are use of growth stimulants and effective cross-breeding.

Summary

Pasture renovation is not practiced often enough by beef producers to allow development of good skills. To expect economic returns to be above costs in your pasture program, care must be taken to ensure the desirable plants selected for introduction have a high probability of increasing carrying capacity and possibly livestock performance.

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IMPLANTS - WHAT'S THEIR STATUS

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Growth promoting implants are one of the most profitable management tools available to the beef cattle industry. Effective use of implants can greatly enhance the profit potential of a cattle operation yet it is unfortunate that many cattlemen do not fully take advantage of or understand the economic benefits to be derived from implants.

A good understanding of how implants work, how they can be best used, and following proper implanting technique will result in more effective utilization of this concept in the beef cattle industry.

What Are Implants?

Implants vary in size, shape and growth promoting contents depending on the brand and type of implant. Virtually in all cases, however, the implants contain a growth stimulant that is slowly released into the blood circulation. The recommended location for use of implants is under the skin on the back of the ear with some variability on that location existing among implant types.

Implants commonly used on the North American continent include:

RALGRO® implants contain the compound zeranol which is a derivative of a natural metabolite of the mold, Gibberella zeae originally found on corn. While not a hormone, it appears to affect the release of certain hormones in the body and is classified as a protein anabolic (building) agent. RALGRO implants are effective in growth promotion for all ages of cattle.

Synovex® effectively promotes growth with suckling, growing and finishing cattle. It comes in three forms, Synovex-S® is for growing and finishing steers and contains 200 mg. of progesterone and 20 mg. estradiol benzoate while Synovex-H® is for growing and finishing heifers and contains 200 mg. of testosterone and 20 mg. of estradiol. Synovex-C® is the newest form and it contains 100 mg. of progesterone and 10 mg. of estradiol benzoate and is intended for suckling calves.

STEER-oid® is similar to Synovex-S in make-up (progesterone 200 mg. and estradiol benzoate 20 mg.) and biological activity.

Compudose® is a new long lasting implant made with estradiol-17 β mixed with silicone rubber to form an exterior coating on a solid silicone rubber core. The active hormone estradiol-17 β is dissolved in the silicone rubber and when implanted in an animal the hormone migrates out of the implant at a constant rate. These implants can

be manufactured to have hormone release patterns extending over long periods of time. Compudose-200® is an implant designed to last at least 200 days.

What Types of Cattle Respond to Implants?

1. Steers - Extensive research on the North American Continent has shown that steer calves whether in the suckling, growing or finishing phase will respond to an implant. There is ample evidence that considerable variation does exist between animals in how they respond but generally a 5-15% response in improved gain is noted. Unfortunately, no clear cut explanation exists as to why certain animals respond more than others.
2. Heifers - As with steers, heifers in the suckling, growing and finishing phase show a response to implants. In cases where heifers have been spayed implants have still improved gain.
3. Bulls - Considerable research data has been done on the use of implants with beef bulls intended for slaughter. In bulls fed for slaughter, there has been less response in improved average daily gain than with steers. There is, however, ample evidence that implants will alter the sexual development of the bulls resulting in improved carcass characteristics especially improve palatability or tenderness of the meat. For maximum beneficial response, the bulls should be implanted within 3 months of birth and every 100 days to slaughter.
4. Implanting Cullled Cows - Annually from 10-15% of a commercial cow herd is culled with more and more cow/calf producers putting these cull cows on some type of a growing or high concentrate diet to increase weight and flesh on the cows thus improving their market value. Limited research data exists on use of implants with cull cows; however, work with RALGRO has shown that cull cows respond to RALGRO with the magnitude of the response similar to that achieved with heifers on a growing or finishing program.

Now Let's Be More Specific in the Response of Cattle to Implanting Systems

In the beef cattle industry, there are many production systems with considerable variation in the way cattle are handled from the time they are born until they are slaughtered. In reviewing the effectiveness of implants, let's evaluate how they might be used in various situations and what effect it would have.

1. Implanting suckling calves - One of the areas where the value of implants is often overlooked by cattle producers is during the suckling phase. The value of implanting suckling calves and the effect of timely implantation on the response is shown in the following two tables:

As can be noted, the improved weight gain ranged from an average of approximately 4% when one implant was used to as high as 8% improvement in weaning weight when two implants were used during the suckling period (60-100 days apart). As is noted in table 2, when only one implant was used, it was slightly more advantageous to use it at the time the calves were 2-4 months of age as compared to using implanting fairly close to birth. One of the unexplainable aspects of using implants, particularly with suckling calves, is the variation in response that occurs. As can be noted in the tables, the response ranged from 8 lbs to nearly 30 lbs when one implant was used. Further evidence of this has work done with cooperating producers in Saskatchewan in which response in three herds varied from no response in one herd, a 9 lb improvement in the second and a 36 lb improvement in the third in 143 day trials.

Another question commonly asked about using implants with suckling calves is, when they are used with heifers that are then kept as replacements, what impact is there on subsequent reproductive performance? The following points summarize the research work that has been done.

1. If a producer knows that he is going to keep a heifer as a replacement, there's no advantage to using an implant with that heifer. She will be slightly heavier at weaning, but the possible danger of slight impairment in reproductive performance discourages the routine use of implants with replacement heifers.
2. Use of an implant immediately at birth with heifers that are kept as replacements has resulted in impaired reproductive performance when bred as yearlings. Most of this research has been done with RALGRO since this is the most commonly used implants during the suckling phase. When used immediately at birth, an implant has been shown to reduce first service in overall conception rates by as much as 25-40%. Part of this may be explained by the higher incidence of infantile reproductive tracts in the implanted heifers.
3. Implanting replacement heifers at 2-4 months has shown no effect of subsequent reproductive performance. Considerable research has been done on implanting heifers at this age and virtually all show no impact on later reproductive performance. Thus, in instances where a producer is unsure of whether he will keep a heifer as a replacement, it appears that implanting at this age will not impair later productivity.
4. Implanting at weaning time has shown some variation in the effect on later reproductive performance. In general, an implant at weaning time has not impaired the reproductive performance of replacement heifers. However, a few studies have shown a slight reduction such as a 5-10% reduction in first service in overall conception rate. Usually by the time a heifer has reached weaning a producer has decided whether he will keep her as a replacement or not.
5. When heifers are implanted at a young age, such as birth or 2-4 months of age, and then reimplanted 60-100 days later there's been a definite reduction in first service and overall conception rates. Thus, multiple use of implants with replacement heifers can create serious problems.

In cases where a purebred producer is raising bulls intended for breeding purposes, they should never be implanted. Considerable research data has shown that implanting bull calves within the first three months of birth causes a fairly severe reduction in testicular development.

Table 1. Effect of implants (Ralgro) on weight gains of suckling calves.

	<u>Increase in weight compared to nonimplanted calves.</u>			
	<u>One implant</u>		<u>Two implants</u>	
	<u>Pounds</u>	<u>Percent</u>	<u>Pounds</u>	<u>Percent</u>
Corah, 1977	8.0	2.8	43.0	14.3
Davis et al., 1977	21.0	6.7	27.0	8.7
Ward et al., 1978	16.5	4.1	25.0	6.5
Sand, 1978	18.0	4.6	25.8	6.5
Bartlett and Ritchie, 1979	25.7	7.8	19.9	6.1
Whittington et al., 1982	29.7	8.0	31.1	8.5
Simm, 1983	<u>9.7</u>	<u>2.9</u>	<u>19.4</u>	<u>5.9</u>
AVERAGE	18.4	5.3	27.3	8.1

SOURCE: Mader, Nebraska - 1983 Range Beef Cow Proceedings

Table 2. Effect of time of implantation and number of implants (Ralgro) on suckling calf performance.

	<u>Increase over nonimplanted calves</u>					
	<u>One Implant</u>				<u>Two Implants^b</u>	
	<u>Early</u>		<u>Late^a</u>			
	lb.	%	lb.	%	lb.	%
Davis et al., 1977	18.5	(6.0)	22.6	(7.4)	26.7	(8.7)
Sand, 1978	14.7	(3.7)	21.4	(5.4)	25.8	(6.5)
Ward et al., 1978	<u>13.0</u>	<u>(3.4)</u>	<u>20.0</u>	<u>(5.3)</u>	<u>25.0</u>	<u>(6.6)</u>
AVERAGE	15.4	(4.4)	21.3	(6.0)	25.8	(7.3)

^aImplanted 90 to 100 days after early implanted calves.^bReimplanted 90 to 100 days after first implant was given.

SOURCE: Mader, Nebraska - 1983 Range Beef Cow Proceedings

Implant Use in Growing Programs

Considerable research throughout the world has shown that implants show a very consistent beneficial response with growing calves. Implant usage during the growing period has shown a consistent 20 to 40 lb improvement in weight gain in 125-160 day growing programs. An illustration of the weight gain improvement possible is shown in the following table.

Table 3. Yearling weight gain improvement due to RALGRO.

PROVINCE OR STATE	TOTAL GAIN IMPROVEMENT DUE TO RALGRO (lbs)	AVERAGE INITIAL WEIGHT (lbs)	DAYS ON TEST	CODE
Manitoba	37.0	742	127	P
Manitoba	36.0	649	101	C
Saskatchewan	30.0	513	92	P
Ontario	20.5	625	128	P
Alberta	35.0	640	113	P
Nebraska	23.9	513	126	P
Idaho	23.6	533	124	P
Kansas	22.8	480	152	C
Oregon	<u>25.8</u>	<u>507</u>	<u>112</u>	C
AVERAGE	28.3	578	119	
CODE:	P - Pasture	C - Confinement		

SOURCE: Hemstad, Manitoba - Proceedings of meeting
Implanting For Growth, 1984.

Comparison of implant programs for finishing steers.

A tremendous amount of research has been done on the value of implanting during the finishing phase. A summary of twelve trials is shown in the following table.

Table 4. Effect of implants on weight gain and feed efficiency of finishing steers.

Source	Initial Weight lbs.	Days on Feed	Implant Treatment							
			Control		Single		Reimplant		Compudose	
			ADG	F/G	ADG	F/G	ADG	F/G	ADG	F/G
KS	850	111	2.66	---	2.80	---	---	---	2.86	---
KS	735	128	2.73	7.87	---	---	3.14	7.22	2.98	7.43
KS	630	146	2.75	7.04	2.93	6.83	3.25	6.42	3.08	6.48
MN	705	164	2.65	7.20	---	---	3.04	6.29	2.99	6.39
MN	733	164	---	---	---	---	3.12	6.31	3.16	6.23
ND	620	154	3.04	7.00	3.10	6.90	3.30	6.47	3.33	6.47
KS	700	132	---	---	---	---	3.67	6.85	3.55	6.89
CO	655	168	2.62	6.49	3.02	6.09	3.07	6.00	3.04	6.01
ID	615	160	2.62	6.90	2.79	6.65	2.94	6.35	2.87	6.56
KS	665	140	2.37	---	2.80	---	2.94	---	2.56	---
KS	653	167	2.28	8.66	2.52	8.23	2.81	7.60	2.67	7.86
SD	647	169	2.83	7.00	3.09	6.68	3.38	6.36	3.23	6.54

SOURCE: Laudert, Kansas State University - Focus on Feedlot newsletter, 1984.

A total of 1,673 steers were used in these twelve trials. The average initial weight of the steers was 685 lbs. and the average time on feed, 150 days. Summarizing the results the COMPUDOSE implanted steers gained 11.3% faster and 7.6% more efficiently than non-implanted steers and 2.8% faster and 3.6% more efficiently than steers having either a single RALGRO or single SYNOVEX implant during the finishing period. However, if the steers were reimplanted with RALGRO or SYNOVEX-X during the finishing period, they gained 3.6% faster and 1.5% more efficiently than COMPUDOSE implanted steers. Reimplanting with RALGRO and SYNOVEX as compared to a single RALGRO or single SYNOVEX implant showed 7.3% faster weight gain and 5.4% more efficient weight gain. In comparing steers implanted twice during the finishing with either RALGRO or SYNOVEX as compared to non-implanted controls there was a 17% improvement in weight gain and a 9.4% improvement in feed efficiency. All of this verifies a very positive and economic benefit of implanting finishing cattle.

SUMMARY

Considerable research has been done in the North American Continent evaluating the potential benefits of implants in beef production systems. This research clearly indicates that one of the most profitable management practices a cattle producer can use is to incorporate implanting into his management practices. Exactly when and how that producer utilizes the implants will vary from operation to operation.



WHEN THE WIND BLOWS EVEN THE TURKEYS FLY

James H. Leachman
Leachman Cattle Company
Billings, Montana

As a mature industry, the wind no longer blows in the cattle business. To survive, prosper, and succeed as a cattle breeder for the long run, programs must have a balance between management, genetics, and marketing. Many existing operators will need more than a turkey under their arm for spare parts to stay alive. Those who implement this three-pronged program will share unparalleled success.

For more information see Leachman's video film, "Hell Bent For Leather to Meet the Needs of the Commercial Cattlemen" and his slide presentation.

by

Dr. Frank Baker, Manitoba Agriculture

The use of drugs in a profitable livestock operation today is unavoidable and essential. It is equally essential that the persons administering these drugs fully realize the great responsibility that is placed upon them. Failure to recognize and carry out that responsibility may result in an economic loss for the enterprise and/or, the creation of a human health hazard. It is the failure to carry out that responsibility that rests heavily and squarely on your shoulders that I'd like to discuss with you today.

Abuse means improper use. In how many ways do you think drugs, intentionally or unintentionally, are likely to be abused in a livestock operation today? The answers to that question would likely indicate your concern about the irresponsible use of antibiotics which results in the development of resistant bacteria and in tissue residues which may be responsible for the development of sensitivities to antibiotics in humans. In short, you tend to think only of the illegal use of drugs. I'm going to discuss these aspects first because they are so important, but I hope to find time to impress upon you that there are many ways that drugs can be abused quite legally and result in economic losses in your livestock operations.

What are the consequences of drug abuse?

1. Failure of the drug to perform as expected, resulting in:
 - a) continuation of the present disease condition,
 - b) the possible creation of new disease problems,
 - c) waste of money that was paid for the drug,
 - d) in the case of vaccines, animals that are not effectively immunized and protected.
2. The creation of a potential hazard to human health from poisoning.
3. In the case of antibiotics:
 - a) the development of resistant bacteria,
 - b) the presence of residues in meat or milk resulting in the development of sensitivities to antibiotics in certain people.

Let's first discuss the consequences of the irresponsible or unnecessary use of antibiotics. Unless scientists can discover, and soon, new antibiotics or unless we use antibiotics with far more care and discrimination than we do at present, we may be heading for a time when the benefits of antibiotics will be denied us. Just as flies became resistant to DDT through continuous exposure to it, bacteria are becoming resistant to antibiotics. Bacteria that become resistant

to antibiotics pass that resistance characteristic to their offspring. As if this isn't frightening enough, certain bacteria have the ability to transfer that resistant characteristic to other bacteria that they have contact with.

As shown in these slide illustrations, it is wrong to say, as probably everyone in this room has said sometimes when using antibiotics, "If it doesn't do any good, it won't do any harm!"

Bacteria gradually lose the resistant characteristic if they are not exposed to that particular antibiotic for a period of time. So it is wise to alternate the use of different antibiotics periodically for a particular condition if possible.

Antibiotics are only effective against certain infectious diseases and should never be used for noninfectious diseases unless a veterinarian recommends their use to prevent secondary infections. Antibiotics are ineffective against most viral infections.

The other serious abuse of antibiotics is the failure to withhold from market channels, for a specified period of time, animals to which antibiotics have been administered. Let's consider penicillin for example. An injection of procaine penicillin is effective against bacteria in the animal's body for about 24 hours, but even though it is no longer effective against the bacteria, it is present at very low levels in the animal's tissues for 72-96 hours after the injection. Certain people eating the meat or drinking the milk from such an animal may develop a sensitivity to penicillin which, while not affecting the person at that time, may result in a severe reaction or even death when that person receives penicillin medication in the future. The same can be said for other antibiotics. It is for this reason, and to avoid the development of resistant strains of bacteria in human medicine, that long acting penicillin (Benzathine Penicillin) and Chloramphenicol can only be obtained, by prescription, from a veterinarian.

All antibiotic preparations have a withdrawal period clearly printed on the container label. Failure to honour that withdrawal period is a matter of criminal negligence that may result in the severe illness or even death of a person.

Added to these already noted dangers of antibiotic administration is the hazard of personal injury when handling these products. The same care should be taken when handling drugs as when using any other potentially dangerous chemical preparation.

Chloramphenicol, one of the more modern and most powerful antibiotics used in human and animal medicine today, is a good example. Veterinarians sometimes recommend it be used in cases of calf scours and pneumonias. In rare instances it can cause very unpleasant side effects. In humans, for example, it may cause blood abnormalities. Such instances are more likely in children and the elderly.

Recently the death of a Kansas farmer was circumstantially linked to improper use of chloramphenicol. The farmer was injecting feedlot cattle with an oral solution of chloramphenicol. It is suspected that the drug was absorbed through a cut in his hand during handling.

What Are The Most Common Abuses of Drugs?

The most common abuses of drugs are neither illegal or dangerous, but they are important because they result in the waste and ineffectiveness of the drugs.

1. Failure to store the drug under proper conditions. All vaccines, some antibiotics and vitamins and most hormone preparations must be stored in a cool place. They must not be allowed to freeze. Certain drugs must be kept out of the light. Storage conditions are printed on the containers of drug preparations and should be observed at all times. It is not illegal to improperly store a vaccine or antibiotic, but to do so is certainly abuse and will result in the failure of the drug.
2. Overdosing of drugs. The all too common maxim "if a little is good a lot must be better" should never be applied to the use of drugs. Overdosing (and underdosing) is drug abuse. Not illegal, but certainly abuse.
3. Improper route of administration, i.e. giving a drug intramuscularly instead of subcutaneously.
4. Careless administration of drugs, particularly vaccines that are given in small doses. Haste and sloppy techniques can result in less than the required amount being given. Successful vaccination depends upon two very important factors: 1) The amount of antigen (that is the number of bacteria or virus particles) that is injected into the animal, and 2) the length of time the bacteria or virus particles stay at the site to stimulate antibody production. I wonder how many of our so-called "vaccine breaks" are due to this kind of drug abuse.
5. Use of dirty or contaminated equipment such as needles and syringes.

6. The administration of a particular drug to a species of animal for which the drug has not been authorized. "Not for use in food producing animals" on a label doesn't mean that it's okay to use it if no one else knows about it. An illegal abuse of a drug.
7. Not keeping to the recommended duration time of treatment. If the label or the veterinarian says "20 cc for 5 days" don't discontinue the treatment after 3 days or continue for longer than is necessary.
8. Using outdated products. Check the EXP date before buying and before using any drug. The danger of using outdated products is not only that of lowered potency, but also the development of harmful degradation products as the drug deteriorates.
9. The use of partially used bottles of vaccine. Unlike penicillin, vaccines have no preservatives in them to allow partially used bottles to be stored in the "fridge" and used later.
10. The mixing of incompatible drugs. Unless you're a pharmacist, you don't know what drugs are compatible. If the drugs are not mixed when you buy them don't you mix them or even put them together in the same syringe.
11. The use of a drug that is restricted to use by a veterinarian only.
12. The improper disposal of old or unwanted drugs and empty drug containers. Return to the distributor or burn or bury them.

Don't use drugs of any kind unless you do so for a specifically understood purpose. The only safe guide for drug use is that of following completely the directions on the drug container or the written directions of a veterinarian.

If in doubt, consult your veterinarian.

Always read the label!

by

Dr Jim Neufeld, Manitoba Agriculture

Historical Aspect

The Province of Manitoba, through the Department of Agriculture, many years ago recognized the need for diagnostic services to the live-stock industry. Dr. Alfred Savage arrived early in the 1920's fresh from his training at McGill, service in the First War and teaching at MacDonald College, to join the civil service of the province and set up a Department of Pathology and Bacteriology. The section was housed at the College of Agriculture in Fort Garry, which later amalgamated with the University of Manitoba. In 1938 Dr. Savage was appointed Provincial Animal Pathologist. This was a sequelae to his very capable efforts in responding to the severe outbreak of Sleeping Sickness in horses in 1937. His main effort in combatting the disease was to organize the distribution of vaccine for prevention of the disease. This is very likely one of the earliest uses of mass vaccination to control an important disease in livestock-the first to be carried out on the prairies. Dr. Savage continued in this capacity until his retirement in 1958.

The diagnostic facility continued to operate out of the agriculture faculty at the University of Manitoba until the opening of a new building in 1972 - the Agricultural Services Complex. This greatly expanded facility provided the necessary room to implement state of the art procedures in diagnostic veterinary medicine and now provides the most up-to-date and advanced services possible for the livestock producers of Manitoba. It operates under the guidance of the Director of the Veterinary Services Branch, within the framework of the Department of Agriculture, which is headed up by the current Minister of Agriculture.

Clients and Reporting

In-depth, specialized laboratory support is provided for veterinary practitioners, livestock producers, poultry interests, pet animal interests, and government staff in regulatory, research (R.O.P.), and law enforcement functions. It is the preference of the laboratory to work through the local veterinary practitioner, since they are best equipped to evaluate and identify client-producers' problems which require laboratory assistance. The laboratory will work directly with those clients who prefer it that way, but often laboratory findings can only serve as an aid to diagnosis and should not be used as a substitute for good clinical examinations and evaluations. Results of tests, specimen evaluations, and analyses are reported to the practitioner for consideration in formulating a diagnosis and recommending appropriate treatment, unless otherwise requested. Owners of food-producing animals who deliver carcasses to the laboratory always receive copies of final reports, as a courtesy.

Specimens, Quality and Services

The Manitoba Veterinary Medical Diagnostic Laboratory is the only facility in the province which is geared to offer essential diagnostic

testing to the livestock community and veterinary interests. There is no private service in existence of a comparable nature.

The laboratory is prepared to accept and process almost anything from large mammalian carcasses to small chicks or pets. Many specimens from clients' animals are sent in by veterinary practitioners, both rural and city. The results that are generated are only as good as the specimens received. Therefore it is vitally important that live, sick animals, or freshly dead carcasses are presented for post mortem examination. Often swabs, fluids, blood, feces, or biopsies are collected from live animals. The chances of making a clear-cut diagnosis rapidly diminish as the time after death increases. The intestinal tract rapidly auto-digests its epithelial lining and is virtually useless after 12 hours, for rendering an accurate diagnosis.

The laboratory offers services in the specialties of pathology, histopathology, bacteriology, clinical pathology, virology, toxicology, and field services. In 1984 the laboratory handled approximately 6,500 carcasses and tissues, 4,125 blood and serum samples, and 1,070 poultry cases, for a grand total of 11,695 diagnostic specimens. This is a record volume, and is a 10% increase over 1983.

Processing takes differing times to complete in each section. Histopathology requires 48 hours to process and a few days for interpretation by the pathologist on duty. Bacteriology usually requires 3 days for culture and sensitivity. Therefore, a fairly comprehensive diagnosis can usually be rendered in a week to 10 days. Rapid techniques such as immunofluorescence and negative staining electron microscopy provide identification of disease-causing agents in 48 to 72 hours. Significant findings are usually telephoned to the veterinary practitioner.

Identification of viruses, and serology (to detect antibodies to disease) can take much longer, since live tissue cultures must be grown. Results from virology usually take from one to 2 weeks. Serology is a useful tool (using blood samples from live animals), but it requires two samples about 14 days apart from the same animal (acute and convalescent) to produce significant results.

Blood samples tested in the clinical pathology section yield results in the areas of blood cell counts, clinical chemistry, urinalysis, etc. These results are telephoned out the same day to aid the veterinarian in choosing treatments for live animals.

In the toxicology section, serum and tissues are tested for toxic substances - primarily micronutrients and heavy metals. Special tests not available in-house, are sent out to reference labs.

The laboratory also provides an invaluable service in Public Health Surveillance. It provides monitoring of Western Equine Encephalitis activity each summer. It maintains a watchful eye for diseases transmissible to humans such as Toxoplasmosis, Salmonellosis (typhoid), to name but a few.

Laboratory staff are available to conduct field investigations when requested to do so by the local veterinary practitioner. This may be necessary when a particularly difficult or disastrous herd problem needs resolution very quickly.

Economic Impact

Laboratory services are an essential back-up to the local veterinary service. The World Health Organization has determined that for every dollar spent in veterinary laboratory services, the benefit is \$7.50 to the livestock community. Studies at our own facility estimate this return to be higher, between \$10 and \$20, which represents the saving to producers in preventing death losses during disease outbreaks. The much greater benefit of identifying disease agents which can be made into vaccines cannot be measured. Prevention of disease by vaccination is the most economical way to maintain animal health. Without a provincial diagnostic laboratory, producers would have little idea of significant diseases in their herds and would have great difficulty in determining which vaccines were necessary.

Fees and Charges

The laboratory has found it necessary to charge basic fees for its services. These can be obtained from your local veterinary practitioner or by calling the laboratory. The tremendous cost of equipment required, has forced the laboratory to defray some of the expense through application of service fees.

Summary

The veterinary diagnostic laboratory is committed to providing rapid, accurate disease diagnosis to poultry, livestock and pet interests within the province of Manitoba. It is a major reference centre, providing scientific expertise and advice on demand to those who need it.

If you need assistance please feel free to call 945-7652 for further information.

Invited Lecture to the 1985
Manitoba Beef Cattle Seminar in
Brandon, Manitoba
January 22, 1985

Processed Crop Residues as Alternate Feed Sources

First of all I wish to thank Norm Hemstad and Jerry Gramiak for inviting me to speak to you today. I certainly hope that something I have to say will be of some practical value to some of you. I heard the first of two talks this morning and found them very interesting as I'm sure you did as well. I hope I can live up to the standard they have set.

Introduction and history of chemical processing

I am employed as a research scientist with the Saskatchewan Research Council at Saskatoon. For the past ten years our group has worked with animal and crop scientists at several Agriculture Canada Research Stations and the University of Saskatchewan on processing crop residues. The objective of this work was to try to give the cow-calf operator an alternate choice of feed for maintaining cows throughout the pregnancy period. We believe that if our processing methods can be adapted to a producers system, he would be able to utilize his crop residues more effectively, and in doing so, considerably reduce his feeding costs, especially when conventional feeds are in short supply.

This talk is based upon one chemical processing system, but before I get into that I'll give you a brief history of some of the other chemical processes. Physical processes such as chopping or hammermilling can be useful but I will leave that to Dr. Beacom of the Melfort Research

Station of Agriculture Canada who has done a great deal of work in this area.

The chemical processing of straw to improve its value as feed for ruminant animals has been used extensively in Europe for many years. During the First World War a German chemist by the name of Beckman (1919) treated straw with a dilute solution of sodium hydroxide or lye and found a significant improvement in the feeding value of the solids remaining after draining off the basic solution. This process was used in Norway for many years until their rivers became polluted from disposal of the spent liquors and the process was abolished.

Several years ago Rexen and Thompson (1975) in Denmark, developed a process of spraying chopped staw with concentrated sodium hydroxide and pelleting it under high temperature and pressure. This system appeared to work quite well and several plants were built in England to produce sodium hydroxide treated straw cubes for livestock. Unfortunately for the processing plants, rainfall has been very good in England since that time, the hay production has been high, and the plants have not been operating.

Work is still being done with sodium hydroxide but although it is very effective in increasing the in vitro digestibility of the residue, it has several disadvantages. First of all, lye is a very corrosive chemical and is dangerous to handle. Secondly, animals feeding on a sodium hydroxide ration require large amounts of water. Also, there have been comments in the recent literature that, although the in vitro digestibility of sodium hydroxide treated straw is high, large concentrations of sodium in the rumen may actually inhibit digestion. One of the reasons we

decided not to use sodium hydroxide is that most of the sodium in the residue is excreted in the urine and feces. This would tend to add to salinity problems we have in the prairies and that would not be desirable.

Many other chemicals such as potassium hydroxide, calcium hydroxide, various acids, and even sulfur dioxide have been investigated, but none of these chemicals are widely used. The two chemicals which produce a residue having almost complete digestibility are concentrated hydrogen peroxide and hydrogen fluoride. These provide a pulping action on wood or crop residues but at the present time are far too expensive for this purpose.

Stake Technology (1978), a Canadian company now located in Oakville, Ontario, developed a technique called "steam explosion". The material to be processed was exposed to high pressure steam for a very short time and the pressure released abruptly. The result is a combination of an acid hydrolysis and a physical disruption of the fibres in the residue. The process works very well with aspen chips and sugar cane bagasse and Stake has built plants in other countries to treat these materials. Although the digestibility of straw was significantly increased and it showed up well in animal trials, it ends up with 50% moisture at a pH, or acidity, which is not low enough to prevent molding. Therefore steam exploded straw would have to be used immediately or dried at considerable expense.

The earliest report I located about the use of anhydrous ammonia for processing straw was by Zafren (1961), a Russian scientist. They reported digestibility and other feeding data but did not give many processing details. The treatment looked interesting as it seemed to give

almost as good an increase in digestibility as sodium hydroxide even though it is a much weaker base. It also adds nitrogen in a form which can be utilized by ruminants.

At the beginning of this work we were aware that a group from the United States Department of Agriculture at Berkley, California under Dr. Kohler (1975) were investigating the effect of aqueous ammonia on rice straw. Aqueous ammonia is not under pressure, as is anhydrous ammonia, and would be safer to use from that point of view. We decided, however, that proper precautions could be taken and that application difficulties which may be encountered would make the aqueous ammonia hard to apply from a practical standpoint.

Since that time another method was devised by Bergner and Marienberg (1971) in Germany. Urea or ammonium carbonate was added to hammermilled straw and ammonia was produced in situ by pelleting the mixture under high temperature and pressure. Although the initial results of this process looked promising, later results were very inconsistent and some doubt has been thrown on this process.

Recently a process called "Ammonia Freeze Explosion" or AFEX treatment was developed by Dr. Bruce Dale (1982) of the Agricultural and Chemical Engineering Department of the Colorado State University at Fort Collins, Colorado. The process is similar to the Stake process except it uses anhydrous liquid ammonia instead of steam. The product from this treatment is very good and Dr. Dale feels that the treatment cost is in line with other processes since he is able to recover most of the excess ammonia.

Dr. Dale may be correct as far as his costs are concerned, however,

his process, and most of the other methods I have mentioned, require considerable capital expenditure which is one of the things we were trying to avoid.

Development of our ammoniation process

We decided to investigate the anhydrous ammonia process for the following reasons -

1. It appeared to work quite well, improving the digestibility and crude protein content of straw.
2. Air pollution was minimal compared to ammonia pollution from other sources such as manure and fertilizer.
3. The application of ammonia was simple and not dangerous when applied by an experienced fertilizer dealer.
4. Capital cost is minimal as only pipes and connectors are required.

Our first work back in 1975 was done on a laboratory scale. Most of the work was conducted on Neepawa wheat straw as it was the most common cereal grown in Saskatchewan at that time. New varieties to replace it are only now coming on the market.

For this small scale investigation we first made certain assumptions. We chose a moisture content in the straw of 15%. This moisture content turned out to be excellent for the ammonia treatment, but it was almost double the moisture content in baled straw. This caused us a problem down the road as we did not initially realize the significance of this difference in moisture content. Our initial work was done at room temperature, approximately 20°C. We developed a technique for weighing the

amount of gaseous ammonia we were adding to chopped straw. When the straw had been in contact with the ammonia for a sufficient length of time it was removed from the jar, allowed to air dry in a fume hood and analyzed for crude protein and in vitro digestibility using the rumen fluid technique.

From lab scale we moved to 45-gallon drums. It was at this stage of the investigation where we noticed hot spots in the straw after the ammonia had been added, some of these hot spots reached 87° Celcius. Before moving into full size stacks we investigated the ammonia treatment of small stacks.

To this point we found -

1. A ground cover was not necessary.
2. Liquid ammonia gave just as good results as gaseous ammonia and was easier to apply.
3. When 5% ammonia was added the reaction was complete in 5 days (Fig. 1).
4. When 3½% ammonia was added the reaction was complete in 2-3 weeks and the improvement was the same as for 5% ammonia. (Fig. 1).

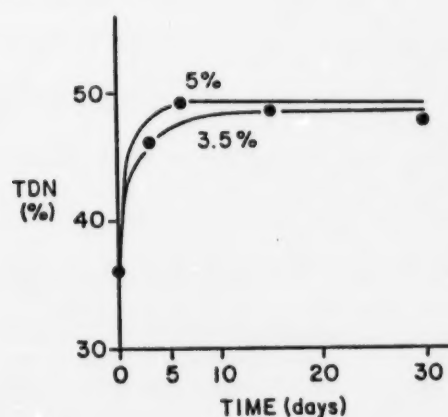


Fig. 1. Effect of ammonia concentration and time on the TDN content of straw.

5. The temperature of the straw was important. Better improvement in digestibility was obtained at higher temperatures at least up to 20°C. (Fig. 2).

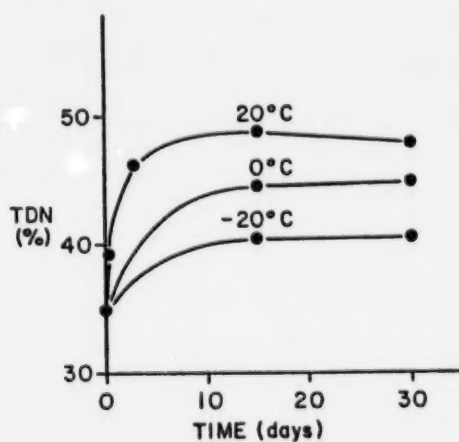


Fig. 2. Effect of temperature and time on the TDN content of straw treated with ammonia.

6. Later we determined that the moisture content was also important. It turned out that if the moisture in the straw was less than 10% the improvement in digestibility was minimal. Secondly, good improvements in digestibility were obtained when the moisture content was above 15%. (Fig. 3). Higher moistures did not produce much additional improvement in digestibility, although some farmers have told me they found the animal acceptability and intake improved at higher moisture contents.

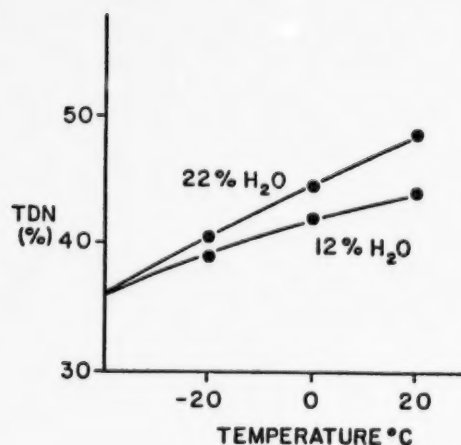


Fig. 3. Effect of moisture content and temperature on the TDN content of straw treated with ammonia.

7. Wheat straw responds to ammonia treatment better than barley straw which in turn responds better than oat straw (Table 1).

Table 1. Average improvement of the CP and TDN content of several cultivars of wheat, barley and oat straw after ammonia treatment.

Cereal Crop	Untreated		Ammoniated	
	CP(%)	TDN(%)	CP(%)	TDN(%)
Wheat	3.3	37	11.5	47
Barley	3.5	39	9.6	47
Oats	3.7	42	8.7	46

Moisture contents of 15-20% moisture have been obtained by baling straw after a light rain or before a heavy dew has been burnt off by the sun. In these cases the moisture is fairly evenly distributed and molding is not a problem. However, if the moisture is much higher than 20% or if water has been added, the stack should be covered and ammoniated

as soon as possible to reduce molding.

I don't plan to go into the practical application of this method in detail since that is covered by our bulletin and the slide-tape shows we have produced. I will only mention the main points briefly. If anyone is interested in more detail they can bring it up during the question period, or catch me later.

In order to carry out this process properly a producer should decide to ammoniate his crop residue long before harvest time. This will enable him to make any necessary arrangements, lay in his supplies and select a location for processing well ahead of time. As soon as possible after threshing, the residue should be collected and the moisture content determined. It would also be advantageous to determine the feeding quality of the residue as well.

Perhaps I should digress for a moment and briefly discuss some aspects of sample analysis and sampling. I believe everyone will agree that a good analysis of your feed is advantageous. However, remember, the analysis can only be as good as the sample submitted to the feed testing laboratory. Some time ago we took a number of samples from a stack of straw at the University. We had them analyzed individually and Table 2 gives some of the results.

Table 2. Variation among bales of Neepawa wheat straw

Bale No.	Crude Protein (%)	TDN(%)
1	4.0	42
2	3.3	40
3	3.1	37
4	2.0	34
5	2.1	35
6	1.5	31
7	1.1	33
8	0.9	30
Average	2.3	35

As you see there can be an extremely large variability from one bale to the next. Obviously, if one were to send in a sample from one bale, the digestibility results could vary from 30% to 42% where the digestibility you need is close to 35%. As you can imagine, a high result could seriously affect the condition of the animals while a low result could significantly increase your feeding costs unnecessarily.

Now, if you are interested in the variability between samples, one can circumvent this problem by taking a lot of samples, submitting them all for analysis and averaging the results. While this would work, it creates a lot of work for the lab and costs a lot of money. The more logical thing to do is to take a number of random samples from all over the stack, combine them and send one sample in for analysis. The question is, how many samples to take to get a combined sample which is reasonably representative of your feed. Some years ago we took a large number of samples from duplicate stacks of hay, untreated straw and ammoniated straw and gave the results to the statistician to play with. Now, no matter what you think of statistics, they can be very useful as you can see from Table 3.

Table 3. 95% Confidence limits

Number of Cores for Sample	CP (%)	TDN (%)
Mean	3.0	44.5
1	1.6 - 4.4	36.4 - 52.6
3	2.3 - 3.7	29.8 - 49.2
10	2.5 - 3.5	42.0 - 47.0
15	2.6 - 3.4	42.4 - 46.6
20	2.7 - 3.3	42.7 - 46.3

What this means is that if you take 10 random samples of this straw and combine them you have a 95% chance of being between 2.5% and 3.5% for crude protein (CP) and between 42% and 47% for total digestible nutrients (TDN). As far as TDN is concerned, 15 samples combined for analysis should put your result within plus or minus 2% of the average TDN of the stack 95 times out of 100. This isn't bad, more samples would be better, but you soon run into the problem of diminishing returns.

I brought this up to show that although feed analyses are certainly worthwhile, the analysis of a poor sample can cause as much trouble as no analysis at all.

The analytical method which gives the best estimate of the digestibility of roughages is the in vitro digestibility analysis. This procedure determines the weight loss of a sample when subjected to the rumen fluid from sheep or cattle under specified conditions. This method will give a measurement of the improvement in digestibility realized after chemical treatment. Unfortunately, the feed testing laboratories in Manitoba, Saskatchewan and Alberta do not use this method any longer. They determine the acid detergent fibre (ADF) content of the forage or residue and relate it to digestibility by means of equations, probably obtained from Penn.State University. Normally the ADF varies indirectly to the digestibility, that is if the ADF is lower the digestibility is higher. As you can see from Table 4, this relationship does not apply

Table 4. Relationship of ADF to digestibility after ammonia treatment.

	Untreated Straw	Ammoniated Straw
CP (%)	3.2	8.9
ADF (%)	53.	55.
TDN (%)	33.	44.

to ammoniated residues. If the ADF content of the ammoniated straw was used to estimate the digestibility, the result would be the same or slightly lower than the digestibility of the untreated sample. The ADF analysis cannot be used to estimate the digestibility of ammoniated residues. Fortunately, the Feed Testing Laboratory at Saskatoon is planning to reinstate the in vitro digestibility analysis.

Now to get back to the ammoniation. The residue with the proper moisture content must be stacked so it can be sealed into a sheet of plastic and protected from wind damage by some means such as tying it down under a fish net. Covering the stack with plastic must be done on a very calm day or it becomes a very difficult task.

The ammonia treatment should be done as soon as possible. For stacks of bales we recommend inserting 20 ft. perforated pipes containing male acme adapters into each end of the stack. The hose on a fertilizer truck can be connected directly to the adapters and an amount of liquid ammonia equal to 3½% of the dry matter content of the residue can be added. Half this amount must be pumped into each end of the stack. A short time after the ammonia has been added, the pipes can be withdrawn from the stack and the holes in the plastic taped shut. We recommend leaving the stack sealed for a minimum of three weeks or preferably until the residue is required for feed. Incidentally it is interesting that when our initial process was complete, we found that two other scientists, Dr. Mowat in Guelph and Dr. Sundstol in Norway had developed similar processes independently.

Now, to quickly review the optimum conditions required for a successful ammoniation.

1. 3.5% ammonia
2. >15% moisture
3. As high a temperature as possible
4. Minimum 21 days reaction time

The advantages of being prepared to ammoniate early in the fall are to

1. Probably have a higher ambient temperature
2. Catch the ammonia dealer before his fertilizing season begins

Chaff

Almost all our early investigations were conducted on straw and the process was developed specifically for baled straw. Most agronomists and specifically Don Rennie (1984), the present Dean of Agriculture at Saskatoon, feel that, in this country, most, or all of the straw should be incorporated into the soil to maintain the organic matter and permeability of the soil, and to reduce erosion. We certainly concur with this and now strongly recommend the collection of chaff, leaving the straw on the soil. Most agronomists have few objections to removing chaff from the land. Our results show that chaff has a higher feeding value than straw, as long as it does not contain too much stem material, and this is another reason to collect the chaff. Table 5 shows the feeding values

Table 5. In vitro feed value of Neepawa residue fractions.

Fraction	% of Plant	CP(%)	Ash(%)	TDN(%)
Total Residue	61	4.9	8.1	36
Chaff	16	7.2	9.0	41
Leaf	16	5.8	11.7	46
Stem	29	3.0	5.6	27

expressed as CP, Ash and TDN of the total residue and the chaff, leaf and stem fractions of Neepawa wheat straw.

Some years ago a fairly large number of farmers in Saskatchewan bought chaff collecting equipment, mostly produced by the Rem Manufacturing Company in Swift Current. Many of these farmers found the chaff vacuum pick up very labour intensive and awkward to use. Most of them stopped collecting chaff and sold the equipment or left it in a corner of the yard to rust.

Now, more effective methods of handling chaff are available. Ted Padbury (1984) of Saskatchewan Agriculture, has completed a study on this phase and found the following equipment in general use.

1. Small Chaff Wagon
2. Large Chaff Wagon
3. High Dump Wagon
4. Fork Lift
5. McKee Stack Wagon
6. Heston Stack Wagon
7. Redekop Chaff-o-matic

The Redekop Chaff-o-matic is the most efficient of these chaff pick-up methods but also the most expensive when we consider that it is a single purpose machine. If time is important, and the equipment can be used to haul several hundred tonnes of chaff each fall, this high cost can be easily justified. The moisture content of the chaff must be adjusted to 15-20%, the stack can be shaped with a front-end loader and covered with a sheet of plastic. Ammonia must be added at many more positions than for a stack of bales, since the ammonia will not equilibrate through the chaff as rapidly.

Two brothers in Saskatchewan farm about 3000 acres and run 175 head of cows. In 1983 they picked up 350 tonnes of chaff with a Chaff-o-matic

and stacked it, ready for ammoniation, in one week at a cost of \$18.00 per tonne. From their past experience they would normally require one month to bale the straw they would need, to cut and bale the hay they would need, and to haul the straw and hay to the farm yard. Mind you, these fellows are pretty well organized. They had completed their harvesting, brought in all the chaff that didn't blow away last fall, ammoniated it, and the treated chaff was ready to be fed before some others got around to considering whether or not to ammoniate. In this case I advised the others not to ammoniate because it was near the middle of October and the weather forecast didn't look so good.

There is another advantage to feeding chaff which is difficult to attach a dollar sign to. We have reasonably well established that ammoniated chaff will provide sufficient crude protein and energy for a maintenance ration for pregnant cows down to -30°C . Below that temperature additional energy may be required. The stacks of chaff can be placed in the feeding area in such a way that they can be fed directly by means of an electric wire. This means of course, that little feed needs to be hauled for these animals, and therefore there is less reason to start up equipment on cold winter days.

Feeding Costs

Most of our data on the cost of ammoniating and feeding ammoniated residues is based on straw. Assuming the process is carried out correctly, the out-of-pocket costs depend strictly on the cost of materials and the amount of residue covered by the sheet of plastic. The major costs, assuming the plastic and fish net are not reusable, are described in Table 6 for a 40 tonne stack of baled straw or chaff and a 10 tonne stack of straw prepared by a Heston or McKee stack loader.

Table 6. Ammoniation material Costs (Brandon, January, 1985)

Material	Cost of Materials (\$)	Cost/tonne (\$)	
		(40 tonne stack)	(10 tonne stack)
Ammonia	385.00/tonne	12.13	12.13
Plastic	135.00/roll	3.38	13.50
Fish net	70.00/net	0.44	1.75
Miscellaneous	= 8.00/stack	<u>0.20</u>	<u>0.80</u>
Total		16.15	28.18

To be on the safe side, let us consider that \$18.00/tonne is a reasonable cost for ammoniation.

In a trial conducted during 1978-79 three different rations were tested on pregnant cows. Table 7 shows the intake and weight gains for these three groups.

Table 7. Daily intake and weight gains for pregnant beef cows

Intake/gain (kg/head)	Brome Alfalfa Hay	Untreated Straw plus 2.3 kg oats 1.4 kg dehy.		Ammoniated Straw plus 2.5 kg oats
Roughage	8.8	4.4		6.6
Bedding				
Untreated straw	2.6	3.2		-
Ammoniated straw	-	-		3.0
Weight Gain	0.20	0.14		0.66

The cost of feedstuffs in the Brandon area in January, 1985 is reported in Table 8.

Table 8. Feedstuff costs (Brandon, January, 1985)

Feedstuff	\$/tonne
Alfalfa grass hay	70.00
Straw	25.00
Oat grain (rolled)	145.80
Dehy. Pellets	120.00

From the figures in these two tables we can determine the present day daily cost of the three rations fed back in 1979. However, remember the animals on the ammoniated straw diet gained more than three times as much as the animals on the other two diets. A ruminant nutritionist estimated that the weight gains would be similar if the oats were cut back from 2.5 kg/head/day to 1.4 kg/head/day for the ammoniated straw diet. We can now use this estimated oat intake to calculate an equivalency cost assuming that the weight gains for the three rations would be similar, Table 9.

Table 9. Daily feed costs/head (Brandon, January, 1985)

Ration	Brome Alfalfa Hay	Untreated Straw 2.3 kg oats 1.4 kg dehy.	Ammoniated Straw	
			2.5 kg oats	1.4 kg. oats
Actual Cost for Trial (¢)	68	70	77	--
Equivalency Cost (¢)	68	70	--	61

During the fall of 1981-82 an on-farm maintenance trial was conducted by Leo Redekop, a producer near Lanigan, Saskatchewan with the help of Bazil Fritz, the livestock specialist from Yorkton, Saskatchewan. His results were based on only eight pregnant Hereford-Simmental cows weighing about 635 kg each. Attempting to compare the results of a maintenance trial

conducted in 1978-9 with one conducted in 1981-82 is certainly not a good scientific approach. In addition to comparing different cows we are comparing different years. Also, neither trial was replicated which reduces their validity. However, since we have been unsuccessful in obtaining grant money to conduct a proper maintenance and digestibility trial, we can only use the data available and must consider the results in that light.

Since 1981-82 was a very cold winter, the results should favor the earlier trial. The feedstuffs table presented previously gives the market value of all the feeds we are considering except chaff. As far as I am aware, a market value for chaff has not been established. We can only consider that the production cost of chaff is about \$18.00 per tonne and based on its feed value, it should be better than straw so let's arbitrarily set the estimated market value at \$30.00 per tonne.

The feed values of the ammoniated chaff and straw used in the two trials are compared in Table 10. Obviously, the chaff has a higher feed value than the straw and should be worth more on that basis alone although keep in mind that all ammoniated chaff will not be this good.

Table 10. In vitro feed value of ammoniated chaff and straw.

Roughage	Ammoniated Chaff	Ammoniated Straw
CP (%)	17.1	7.5
Ash (%)	12.6	6.4
OMD (%)	60	45
TDN (%)	52	42

Table 11 shows the intake and weight gains observed for the two rations.

Table 12 shows comparable feed costs based on estimated equivalent weight gains. The feed cost of the ammoniated chaff, based on the production cost of the chaff, are considerably lower than the feed cost of the other rations. However, I agree, that comparison is not really fair as it is comparing production costs with market value. On the other hand, if you have to buy or sell hay you will do so at the market value and if you collect your own chaff your cost of collecting and hauling chaff is all that you will spend.

Table 11. Daily intake and weight gain for pregnant beef cows.

Trial Ration (kg/head)	Ammoniated Chaff 1981-2	Ammoniated Straw plus 2.5 kg Oats 1978-79
Roughage Intake	15.9	9.6
Weight gain	0.67	0.66
Equivalency Ration (0.2 kg gain)	11.3	straw plus 1.4 kg oats

Table 12. Daily feed cost of equivalency ration.

Ration	Ammoniated Chaff		Ammoniated Straw	Untreated Straw	Alfalfa grass hay
Roughage Value (\$/tonne)	36	48	43	25	70
Equivalency Costs (¢/head)	41	54	61	70	68

This comparison is certainly not straightforward. If, however, we consider the agronomic advantages of taking the chaff off the field and

leaving the straw there; as well as possible savings in time and labour in collecting and feeding chaff compared to baling, collecting and feeding the other rations, the use of ammoniated chaff seems to have a lot of advantages.

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